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ABSTRACT

This document reviews current literature about predicting student success in an online environment and what influences learning online. Online students are often older and more self-directed than traditional college students. They have their own set of cognitive characteristics and expectations of the learning experience. Among the findings of various studies about student success are that online students tend to attribute their success to study habits and discount the role of teacher quality, that experience with e-mail and computers is positively correlated with course performance, and that these students tend to be more self-sufficient. The paper also discusses the dilemma of what constitutes learning. Though past studies have found no appreciable difference or even higher grades for online versus traditional courses, it does not necessarily mean that online students learn more. The paper presents a model for understanding student learning online. This model states that factors that the students bring with them, such as their purpose for taking a course and their attitude about computers, act on the students, who in turn must deal with the technologies employed in the course in order to learn. Directions for future research are discussed. (Contains 64 references.) (LD)

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What Influences Student Learning in an Online Course?

Cathleen A. Kennedy
March, 2000

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Introduction

The widespread introduction of online courses for degree-credit in colleges and universities around the globe has sparked contentious discussion among administrators, faculty, and faculty unions (AAUP 1999, Ehrmann, 1999; Noble 1998; Roschelle & Pea, 1999; Tsichritzis, 1999). Two debates have emerged. The first centers around the *workload* for faculty conducting online courses. One finds broad agreement among faculty and faculty unions that teaching online is more work than teaching in the classroom. Teachers have to develop a new concept of what a course "is" online, develop a new set of instructional materials (after learning how to use the requisite technologies), rethink course pace and activities, and deal with extensive online communication with students (Almeda, 1998; Feenberg, 1999; Friedheim & Jaffee, 1999; Maloney, 1999). Paradoxically, administrators point to online courses as an efficient method of reaching more students without investing in new "bricks-and-mortar" infrastructure. Which, in turn, leads to the second debate: the *quality* of online courses (Agre, 1999; Martin, 1999; Newson, 1999).

While most teachers, administrators and students agree that moderate-sized classes taught in person by experienced professors are ideal, the reality of today's educational environment dictates incorporation of alternate formats into the model: large classes with hundreds of students, extensive reliance on teaching assistants and adjunct lecturers, and distance learning options.[1] How can quality be maintained with less face-to-face access to the cornerstone of

[1] The terms "online" and "distance learning" require some definition in the context of this paper. Distance learning refers to any kind of learning at distance, where the student does not come to the college to attend classes on a regular basis. This includes many formats such as correspondence courses, telecourses, teleconferencing, and online courses. Online courses are courses where the vast majority of the communication and interaction among students

higher education, the professoriate? Professors struggle to accommodate the individual needs of students in the face of high student-professor ratios and consequently less time per student in the classroom; some compensate with extended office hours and the use of email in an attempt to provide students with the guidance and support they need. Resolution of the *workload vs. quality* dilemma is generally left to professors. The problem is especially onerous in online courses where students rarely, if ever, meet the professor in person.

At one extreme, professors can choose to maintain a student-directed tutorial relationship with each student in an online course, implemented through email and online meetings.[2] This optimizes quality at the expense of an exhaustive workload if the course has more than a handful of students. At the other end of the spectrum, professors can conduct a teacher-directed course that keeps students in lockstep and provides minimal individualized instruction or guidance, instead directing students to external resources for remediation or tutoring. This approach optimizes workload, by reducing it, at the expense of educational quality. While the latter approach may work acceptably well in a classroom environment where teachers can at least get visual cues about how well students are comprehending the material from one lecture to the next, in an online environment students can easily become "out of sight, out of mind."

To ameliorate this effect, online teachers need to understand the factors that affect student learning so they can build in safeguards to keep students visible, at least in a virtual sense. For example, if we find that the social context of classroom courses is what keeps students engaged, then we might want to include a social chat room available for students in an online course. If we find that successful students are those who typically do more homework than what is required,

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and teachers is conducted through online technologies such as email, Internet browsers, chats, and asynchronous conferences or bulletin boards.

[2] An online meeting utilizes sound and video to allow individuals to carry on synchronous conversations across the Internet.

then we may want to provide a collection of optional assignments that relate well to the course objectives. The more teachers know about how students learn and the factors that can influence learning, such as the social context and study habits, the more they can develop pedagogies that are effective for online le ners.

This paper explores issues surrounding student learning in an online environment with the purpose of helping teachers develop online learning experiences appropriate for their particular audience of students. The premise is that learning is a complicated endeavor and teachers can have a stronger influence on student success if they know how to identify, understand, and advise students who are having difficulty. The paper begins with a discussion of the problem of predicting which students will be successful (or, more to the point, unsuccessful) in an online environment. Following that are sections on several (latent) variables that seem to influence individual learning in an online environment: the reasons students take a specific course, the ways students have historically interacted with their teachers, the types of study activities students prefer, students' attitudes about using computers, and students' prior experience using online technologies. Next, I take a look at problems with some of the research that has been conducted to assess the quality of online education. I then conclude with suggestions for further research into the effects of online technologies on student learning.

Predicting Student Success

Background

A perplexing aspect of teaching is knowing how to help individual students optimize their performance in a course. For example, in many courses it is nearly impossible to predict which students will do well based on past performance alone. If we could perfectly predict how well students would perform, based on their prior performance, then that would not be such a good thing, as then poorly performing students would have virtually no hope of catching up with better-performing classmates.

The problem of understanding what individual students need is complicated in courses where teachers and students have little opportunity to interact. In the classroom, an important pedagogy involves dialogue that helps the teacher determine a student's area of misunderstanding (NAS, 1997). As Wexler (1999) puts it, "They [teachers] understand with fine discrimination whether the feedback they get from students is a sign of understanding or misunderstanding." The National Academy of Science suggests that teachers can identify student misconceptions through small group discussions, office hours, and other activities that focus on listening to students (1997). Online teachers need different techniques to present materials and engage students in dialogues that help identify misunderstandings (EdNet, 1999; Paulsen, 1995).

How do teachers decide which teaching methods to use in their courses? Since the structure and culture of higher education tend to isolate teachers, most independently determine the pedagogical techniques to use in their classes. Often, teachers use the strategies they experienced themselves as students, or they draw from the repertoire of widely accepted common practice. When the class is to be online, though, few teachers have any direct past experience and there is no established domain of common practice (Jonassen et al, 1995). One

can view this situation as both a challenge and an opportunity. The simplest approach is for teachers to attempt to transfer pedagogies from the classroom to the online environment. Lectures translate to guided lessons and more extensive reading assignments, question-and-answer sessions translate to bulletin boards or online conference threads, and office meetings with students translate to email exchanges or online meetings. From his research into what teachers can do to make the distance education experience more valuable to students, Omoregie (1999) concludes that understanding the needs of learners is far more important than innovative uses of the various delivery systems.

The past two decades have brought dramatic change to the composition of college student bodies, with a trend toward older students. According to the National Center for Educational Statistics (1998), enrollment of students under age 25 increased by 2 percent between 1990 and 1996, while enrollment of persons 25 and over rose by 6 percent. Because adults bring a different set of cognitive characteristics and expectations to the learning experience, their learning is theorized as different from childhood learning. Knowles (1984), often cited as the father of modern adult learning practice, suggested that since adults bring these different qualities to the learning environment, different pedagogies (i.e. *andragogies*) should be employed . Although his distinction between child and adult learning practices may be out-dated now that K-12 teachers are adopting more learner-centered approaches, his characterization of the adult learner is important in the context of the appropriate strategies for online education (Smith, 1996):

> For Knowles, andragogy is premised on at least four crucial assumptions about the characteristics of adult learners that are different from the assumptions about child learners on which traditional pedagogy is premised. A fifth was added later.

1. Self-concept: As a person matures his self concept moves from one of being a dependent personality toward one of being a self-directed human being.
2. Experience: As a person matures he accumulates a growing reservoir of experience that becomes an increasing resource for learning.
3. Readiness to learn. As a person matures his readiness to learn becomes oriented increasingly to the developmental tasks of his social roles.
4. Orientation to learning. As a person matures his time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his orientation toward learning shifts from one of subject-centeredness to one of problem centredness.
5. Motivation to learn: As a person matures the motivation to learn is internal.

The number of professors teaching online is bound to increase dramatically in the near future. The *Distance Education in Postsecondary Institutions: 1997-1998* report (NCES, 1999) found that among institutions offering distance education courses, the percentage of institutions using "asynchronous Internet-based courses" tripled from 1995 to 1998 (to 60% of institutions). In the academic year 1997-98, 78% of public 4-year institutions and 62% of public 2-year institutions offered distance education courses, and most planned to expand their course offerings over the next three years. As more teachers are encouraged to conduct classes online, the need for reliable information about effective learning strategies for online students has become crucial. The National Center for Educational Statistics (1999) recommends further study of "accreditation of and quality assurance in distance education programs" and the "changes and challenges facing the role of postsecondary faculty." Among the key questions to be considered in workshops developed for the National Science Foundation's *Teaching of Mathematics and Science on the Internet* program, are "Which type of student will be most successful online, and how do we encourage other students to participate successfully?" and "How, if at all, should we

alter our methods of information delivery and our teaching styles for online courses?" (Ben-Jacob, 1998, p. 122). The studies summarized below exemplify the types of findings that can help teachers understand the needs of today's online students.

Recent Research

In an experiment at California State University at Northridge (Schutte, 1999) where college psychology students were randomly placed into traditional and online formats of the same course, students in the online course out-performed students in the traditional course on every performance measure. In fact, they performed, on average, 20% better than the traditional students on the midterm and final exams despite having equivalent backgrounds, academic records, and attitudes about computers and the course discipline. What makes this particularly interesting is not just that the students did well in the online course, but that the students didn't volunteer to take the course in an online format.

Examples abound demonstrating "no significant difference" in student performance in traditional and technology-based college courses (Russell, 1999), but the Northridge sample of students is rather unique in the realm of research into online learning because these well-performing students did not self-select into the technology-based course. They were assigned to the course after registering for a traditional on-campus course.

One explanation for the "no significant difference" phenomena is that students who select online courses do so because they are mature, responsible learners who expect to succeed in that environment, and hence, are not representative of the larger student population. These capable students would succeed regardless of the course format. Another possibility is that students select online courses that lend themselves to a "correspondence course" format and therefore are those

who feel that they don't require interactions with an instructor or other students. Such courses are often competency-based or vocational in nature. The Northridge experiment doesn't support either of these explanations: the online students were selected randomly, and the course was a standard general education, social science, liberal studies course; neither competency-based nor vocational.

Given that the simple explanations for online students performing well didn't hold in this study, we are left with the question of why the students performed so well. If it isn't because of initial differences in the students themselves, is there something about the process or experience of taking a course online that improves student performance?

In Fall 1998, I conducted a small study (N=54) at College of San Mateo, a community college in California, exploring student attitudes about online and on-campus courses (Kennedy, 1999, May). Collectively, most students (67%) believed that "teacher quality" was the most important factor for student success in an on-campus course. Conversely, "student study habits" was the most frequently cited factor for student success in online courses (27%) with no students citing "teacher quality" as the most important factor for success in online courses. This suggests that students may have different attribution theories about the two course modes, or may believe that they are assessed differently in the two formats. A fascinating finding of the study was that students who had taken an online course were more likely to report that "student study habits" was the most important factor for student success in <u>both</u> online and on-campus courses than students who hadn't taken an online course. We might ask whether taking an online course changes a student's perception about the most important factors for success in courses *in general*, or whether students who attribute success to their own efforts are more likely to enroll in online courses.

In another study conducted in Spring 1999 among a different group of students (N=321), I explored correlations between the use of online computer technologies, such as email and asynchronous conferencing, and student performance (represented by course grades) (Kennedy, 1999, August). I found a statistically significant (á = 0.01) positive correlation between experience using email and performance (r = .65) and a negative correlation (r = -.47) between feeling awkward using computers and performance for students enrolled in online courses. Although these findings are not in the least surprising, they highlight the importance of student preparation to take an online course and the influence of attitude and computer skills on performance *regardless of academic preparation or motivation to succeed.*

In a study of 450 students at a state university, researchers discovered significant personality differences between distance and traditional students (Biner et al, 1995). In that study, telecourse students were found to be more intelligent, more emotionally stable, more trusting, and more conforming than traditional students. In addition, they tended to be more self-sufficient than group-oriented, and more expedient than conscientious. These results, if found to be generalizable, could have important implications for designing online courses to meet the needs of distance learners. For example, an online course that requires extensive group work may prove counter-productive for some students, despite findings that classroom students seem to benefit from collaborative settings (Kerlin, 1992).

A 1996 study of persistence among 400 distance learners in a graduate level professional program found that perceived intrinsic benefits of obtaining a degree, such as learning to perform their job better or access to recent developments in the discipline, was a good predictor of persistence (Fjortoft, 1996). On the other hand, perceived extrinsic benefits such as career mobility and salary were not good predictors. A surprising finding in this study was that students

with higher levels of "comfort with learning" were less likely to persist in the program. One inference that can be drawn from this study is that capable students may get what they need by only partially completing a program. This has important implications for evaluating the success of online education courses and programs from the standpoint of completion rates. It may also suggest that some students might benefit more, and be more likely to complete their programs of study, if the value of the courses were more apparent. If students aren't deriving benefit from their interactions with the teacher and other students, it may indicate that something needs to change in the course structure or delivery.

A study of the effect of providing optional weekly lectures for a computer-based introductory psychology course yielded some interesting findings (Brothen & Wambach, 1998). The first research question was, Will students come to lectures if not forced? They found that "attendance fell monotonically" from a high of 151 on the first day to a low of 41 during the second to last week of the course. 142 students completed the course. Their second question was, Do lectures benefit student learning? They found no correlation between attendance and self-reported "amount learned." They did find statistically significant correlations of attendance with final exam scores ($r = .53$) and with course grades ($r = .56$), but their overall conclusion was that the lectures did not enhance self-reported student learning. This study illustrates a number of challenges in conducting research experiments in an educational setting, particularly when the findings are contrary to our intuition about how things ought to work. For example, how did they control for initial student differences without using a pre/post test, and what theory explains the low correlation of lecture attendance to self-reported learning but higher correlation to course grade?

Defining Success

One of the challenges to any study of the effects of online education is defining what is meant by *success*. The definition could depend on the audience: Teachers may be most concerned with student learning, students may be most concerned with course grades, and administrators may be most concerned with retention. Even the definition of *learning* has multiple interpretations: We may mean student growth in a specific discipline's knowledge domain; student intellectual growth along the lines of Bloom's taxonomy from knowledge acquisition to evaluative judgment; or, measurement of student ability against a standard model, such as the "A+" examination for the computer electronics industry.

Pace provides additional suggestions for measuring the outcomes of college, emphasizing the difference between *change* and *impact* (1979). In discussing educational research, he warns about arriving at false conclusions when a clear cause for change cannot be determined (p. 5):

> There is another potential for false conclusions, however. It is best expressed by the following line of thought: if we can't prove that something is true, it is probably false. More specifically, if our experimental and statistical methods do not find some unique impact of college or of some particular college experience, a result not attributable to any other source, then there has been no impact.

Wilson also discusses the difficulties inherent in impact studies in educational research (1981) and concludes, "impact studies … have clarified neither the nature nor the magnitude of the changes, nor, more importantly, have they pinpointed the factors which facilitate the desired types of growth" (p. 83).

In their seminal work, *How College Affects Students*, Pascarella and Terenzini (1991) evaluated hundreds of studies of student learning and concluded that grades and grade point average have too many confounding influences to be used for standardized comparisons of students. In particular, they note that grades are influenced by the type of academic institution,

the major field of study, the mode of instruction, course grading policies, instructor rank, and the professor's style and personality. They recommend that if grades must be used they be used "as a measure of the extent to which the student successfully complies with the academic norms or requirements of the institution" (p.63).

What Influences Learning?

Goals and Motivation

In discussing the limitations of using student grades as a measure of learning, Pascarella and Terenzini identify several factors that influence grades at the individual level, including "personal motivation, organization, study habits, and quality of effort" (p. 388). They conclude that "grades tend to reflect not only requisite intellectual skills but also desirable personal work habits and attitudes." Knowles' (1984) concepts of adults' *readiness to learn* and *motivation to learn* are also considered. Knowles asserts that adults are more ready to learn when the educational content is relevant to the learner's needs. He also describes adults' motivation for learning as primarily intrinsic, such as attaining a sense of success and competence, rather than extrinsic such as receiving praise or a high grade. This is consistent with my findings from an informal poll of 40 former online students (Kennedy, 2000). When asked why they had enrolled in the online course instead of buying the books and teaching themselves the course material, only 27% said that they were most motivated to enroll in the online course by getting college credit for their work, while 65% reported that they wanted the benefit of guidance and feedback from a teacher. The remaining 8% specified that they needed to enroll in the course to keep motivated.

Cross (1996) cites attribution theory as a critical component for student learning. This theory suggests that students attribute educational success to something, and that something can be within themselves or not, permanent or temporary, and within their sphere of influence or not. In a study conducted in K–14 schools in Australia (N=346), researchers found that as students gained more experience in school they became more likely to attribute their success to their use of strategies and to attribute their failure to their lack of effort (Clayton-Jones et al, 1992). Dweck and Leggett (1988) also address students' theories of attribution in their study of "helpless" and "mastery-oriented" children. They found that it is goals that generate the helpless or mastery-oriented responses to challenging learning situations, rather than perceived ability. "That is, when individuals are *seeking to increase their ability*, the adequacy of their present level of ability should not be a deterrent to their pursuit of their goal" (p. 259). On the other hand, when students are trying to perform well, their perception of their ability can become an obstacle. They also found that with external manipulation of the situation, such as assigning a highly evaluative task and providing strongly negative feedback about ability in the task area, students would tend to exhibit more performance-oriented behavior. These findings suggest a situational aspect of learning, particularly for students with self-perceived low ability in the content area who are motivated to perform well. When these students are externally oriented (i.e. by the teacher) towards the value of the skill to be learned, rather than toward evaluation of their ability, they are likely to adopt learning-oriented behaviors. Simon ties together the notions of motives, goals, and actions in the learning process (1994, p. 19):

> People have both motives and reasons for what they do. The motives define their goals, and the reasons connect these goals with particular courses of action for realizing them. Thinking begins with goals and cannot move without them.

In a study of adult baccalaureate students studying at distance, Gibson (1996) found that academic self-concept varied over time and across educational contexts. Most students gained more confidence in their ability to study at distance throughout their course of study, but some developed doubts about their competence in the domain of their discipline as they were given greater autonomy and control over their own learning. Findings such as these suggest that some distance education students continue to benefit from a clear explication of teacher expectations of the student and access to the instructor, even after developing competence as a learner.

Student Practices: *Interactions with Teachers* and *Study Activities*

In reporting on a number of studies that looked at the relationship between social integration and academic integration, Pascarella and Terenzini concluded (p. 411):

> [A]cademic integration (as measured by such variables as grades, intellectual development, and contacts with faculty) had its strongest positive influence on persistence or degree attainment for students at the lowest levels of social integration (as measured by such variables as extracurricular involvement and informal interaction with peers).

They also offer conclusions about the net effects of college on the development of general cognitive skills and offer some insight into why college attendance fosters such growth. They cite the concentration of intellectual, cultural and interpersonal influences in a campus setting as a reasonable explanation for the affect of college on student intellectual growth. In fact, their research emphasizes the contribution of student-faculty communication as a critical element in student learning and academic maturity. They also report that "freshman-to-sophomore persistence was positively and significantly related to total amount of student-faculty nonclassroom contact with faculty and particularly to frequency of interactions with faculty to

discuss intellectual matters" (p. 394). In the absence of naturally-occurring interactions with students in the classroom or faculty office, online teachers need to foster strategies that encourage teacher-student and student-student communication. Saba, in his comprehensive survey of distance education (1999) suggests that questions about educational effectiveness should focus on how well instructional programs are designed and how much they provide for teacher-student interaction, instead of on differences in the delivery medium: "The question ... is the proper balance of dialog and structure for different learners, various subject matters, and levels of education" (Saba, 1999).

In considering ways to promote interactions with students, teachers need to consider how a single strategy can have different effects on different students. In an interesting study of the effects of encouraging competition in grade school, for example, Covington describes the different outcomes that resulted for two student groups (1992, p. 134):

> The dynamics just described, including docility and submissiveness, are mostly found in white middle-class schools where respect for authority is the norm and children are well versed in the rigors, the techniques, and the importance of deciding who are the winners and losers. On the other hand, these controlling tactics are less effective among minority students, especially blacks and Hispanics, who, being more cooperative, are likely to band together to make life miserable for the teacher.

Returning to the example of group work in an online course, we may find that cooperating and working in groups associates with learning in a positive direction for one student and in a negative direction for another. Research into the use of extrinsic rewards suggests that intrinsically and extrinsically motivated learners are affected differently by rewards such as grades (Klein et al, 1999). Some students who are rewarded by a grade for participating in group activities, for example, may actually lose interest in the activity once it has taken on the aura of something unpleasant, by virtue of requiring an incentive. What these students might object to is

that a grade for participation rewards completing the task rather than achieving some level of performance. In a study of cooperative learning, however, Kerlin found that "both individual accountability and group rewards were essential to positively influence achievement outcomes in cooperative learning groups" (Kerlin, 1992). One difference in the studies is that Klein's group studied adults and Kerlin studied children. Wilson also addresses the complex nature of defining individual learning styles when he compares a number of conflicting theories about learning styles and finally states, "This example perhaps highlights the slippery nature of the concept of cognitive style" (Wilson, 1981, p. 143).

In a study of the social psychology of learning, McMillan notes that learning cannot be conceptualized as an outcome affected by a few variables, but must be considered as a behavior that is both a process and a product (1980). He cites several researchers (e.g., Magoon, 1977; Cronbach, 1975; Berliner and Gage, 1976; and Stephens, 1967) who stress the need to consider the effect of different situations as interpreted by the learner so that the learning context is defined as that received by the student and not by the instructor or researcher.

An evaluation of the UC Center for Media and Independent Learning online course program, which delivered its first online courses in 1996, found that students wanted more "intense online interaction" than was provided by the earlier courses (Almeda, 1998). Students indicated that they wanted more interaction with their teachers and with other students. This seems contradictory to the Biner study that found distance learners to be highly self-sufficient. In this case, the nature of the courses or student characteristics might explain the differences in the findings of the two studies.

Understanding students' practices, such as enthusiastically engaging in email dialogs or exploring a subject in more depth than required, can provide insights into the student's theory of

causal attribution in the academic setting. In addition, careful observation of student interactions through email, chats and conferencing (the online equivalents to "listening") can help identify extrinsically motivated students who tend to avoid challenging assignments or questions. Covington (1993) points out that cognitive factors, such as appraisal of the quality of one's study skills, can influence a student's sense of threat or challenge in a course. For example, students who believe that they have strong study skills may be able to offset the threat imposed by a course they perceived to be extremely difficult, despite an underlying goal of failure-avoidance. Without strong study skills, such students would continue to behave in ways that avoid failure by withdrawing from the activity or from the course itself.

Identifying online students who appear to attribute academic success to external factors can be useful for three reasons: First, teachers can assist these students by helping them become more aware of and engaged in the process of their own learning. Research by Scapinello (1988), Jagacinski and Nichols (1990), and Clayton-Jones (1992) suggests that teachers can help these students by explaining that effort, persistence and effective learning strategies have more influence on success than inherent ability. Second, these students could be instructed in strategies that successful online students find helpful. This can be accomplished during an orientation session to the online course and supported with a student study guide. And, third, teachers can incorporate a variety of strategies into their online courses to foster a culture of inclusion, respect and community among all the "members" of the course.

At the same time, teachers must consider the needs of students who appear to be motivated by intrinsic factors, such as pride in accomplishment, rather than extrinsic factors, such as praise or grades. In a study of college students, McKeachie (1961) pondered the problem of motivating both kinds of students when extrinsic rewards are emphasized (as in most

classroom situations). His findings suggest that all students will continue to work, but "[F]or the intrinsically motivated student some of the zest is gone. Why is it that we sometimes refuse pay for a good deed we have done? Because the pay would rob us of the good feeling we gain from enhancing our own self-image." (p.468). His suggestion is that achievement cues do not need to be overstated to be effective (even for the extrinsically motivated students), and definitely need to be offset by affiliative and other types of cues. For example, high standards of achievement can be offset by taking a personal interest in students, referring to students by name, and providing informal (i.e. not graded) feedback so students know whether their comments are on the right track or not.

Technology Aspects: *Attitude About Computers* and *Experience with Online Technologies*

Keating and Hargitai also examined social aspects of learning, but from the standpoint of how the Internet has become part of our social communications network (1999). They point out how controversies surrounding the Internet are natural echoes of anxieties about social changes we have experienced in the past; not only anxiety about new ways of doing things, but grief at the passing of familiar tools and methods. Latent anxieties about using technology may also have an influence on learning via computers and the Internet, particularly for older students who have left more traditional artifacts behind. Although most students become more adept users of technology and develop a more positive attitude about technology after a few weeks in an online course, initial difficulties can be so obstructive that students quit the online course (Almeda, 1999; Hara & Kling, 1999). The National Science Foundation's *Teaching of Mathematics and Science on the Internet* program is also interested in answering the question "How familiar with computers should an online student be?" (Ben-Jacob, 1998, p. 122).

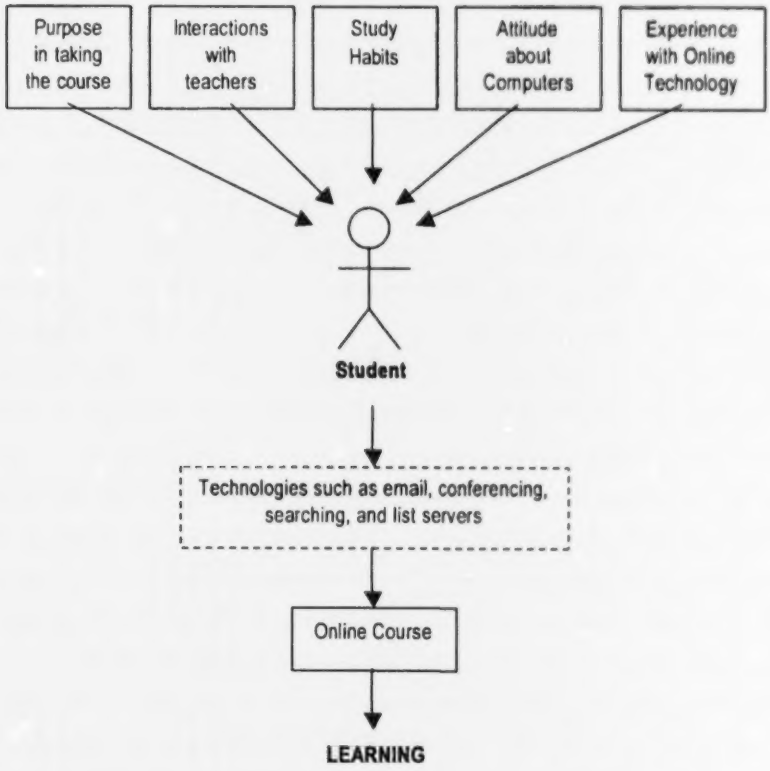
Online teachers need to understand their students' attitudes about using computers and experience using online technologies. Some students do enroll in online courses because they have no other choice, and these students may become easily frustrated with initial failures in the use of the technologies. In my informal poll of former online students, 12% reported that they enrolled in the online course because there was no on-campus course offered, and 55% reported that they could not enroll in an on-campus section of the course due to schedule conflicts (Kennedy, 2000). Hara and Kling (1999) found that online students do not always report the full extent of their frustration to their teachers; with this in mind, then, teachers need strategies to help them discover problems students may be having. In addition, they can provide course orientations and study guides that include extensive coverage of how students should use the various technologies to access the course and interact with the teacher and with other students.

An Emerging Theory of Online Learning

Five variables emerge as having a potentially significant impact on student learning in an online environment. The discussion of goals and motivation suggest that a student's purpose for taking a course sets the stage for becoming more or less engaged in the course, which in turn affects learning. The section on student practices described the importance of student interactions with faculty and student study habits. Faculty interactions are important to help students internalize the values of the academic community, while study habits can more directly enhance or inhibit learning. And finally, the discussion of technological aspects of learning described how one's attitude about using computers and actual familiarity with online technologies can directly affect student learning when technology represents the gateway (or roadblock) to learning activities. Figure 1 is a theoretical model illustrating the causal effects of the confounding variables

identified in this section. These variables are what students "bring with them" to the online course. In addition, all students in a specific course must deal with the various online technologies employed to facilitate access to the course content and activities. The outcome of the student participating in the online course is learning.

Fig. 1: Confounding Effects of the Variables on Student Learning



Research Challenges

Critics of current research into the effectiveness of online education point to several methodological problems. Widely cited criticisms of online education research come from an April 1999 report prepared by the Institute for Higher Education Policy for the American Federation of Teachers and the National Education Association (Phipps & Merisotis, 1999). Phipps and Merisotis reviewed over 40 original works of research to "analyze what the research tells us and does not tell us" about the effectiveness of distance education (p.2). Their analysis identified four key shortcomings of the current research (p. 18-22):

1. Much of the research does not control for extraneous variables and therefore cannot show cause and effect.
2. Most of the studies do not use randomly selected subjects.
3. The validity and reliability of the instruments used to measure student outcomes and attitudes are questionable.
4. Many studies do not adequately control for the feelings and attitudes of students and faculty—what the educational research refers to as "reactive effects."

They also identified six gaps in the current research that invite further investigation (p. 23-28):

1. The research has tended to emphasize student outcomes for individual courses rather than for a total academic program.
2. The research does not take into account differences among students.
3. The research does not adequately explain why the drop-out rates of distance learners are high.
4. The research does not take into consideration how the different learning styles of students relate to the use of particular technologies.
5. The research focuses mostly on the impact of individual technologies rather than on the interaction of multiple technologies.
6. The research does not include a theoretical or conceptual framework.

Although focusing primarily on administrative and corporate exploitation of university faculty and students through the proliferation of online courses, historian David Noble also

addresses the paucity of empirical findings supportive of online education investment in his series, *Digital Diploma Mills* (1998):

> Last but not least, behind this effort are the ubiquitous techno zealots who simply view computers as the panacea for everything, because they like to play with them. With the avid encouragement of their private sector and university patrons, they forge ahead, without support for their pedagogical claims about the alleged enhancement of education, without any real evidence of productivity improvement, and without any effective demand from either students or teachers.

In a discussion of impediments to widespread use of computers in classrooms, Bennett is also concerned with the general problem of interpreting research findings (1997):

> Before any teacher can use a finding, he or she must know of its existence and must be convinced of its efficacy. Neither is automatic. Many teachers are not aware of a great deal of educational research. Even when they do know of a new study, its suitability may be elusive, since research often brings results that can be interpreted differently when used under alternative conditions, by teachers with a variety of skills.

Although Bennett is discussing the issue from the standpoint of classroom pedagogy, the issue has clear parallels to online instruction. In a commentary addressing problems in current research of the impact of technology on learning, Neal states (1998):

> Educational researchers face many difficulties in trying to conduct controlled studies in university settings, because threats to validity and reliability are often beyond the influence of the investigator. As a result, a number of people who are interested in the application of technology to teaching have abandoned traditional research models, opting instead for "proof in practice."

Thomas Reeves is also concerned with the direction of much of this research (1995):

> Most of the research in instructional technology is conducted on the basis of the assumption that education is governed by natural laws and therefore can be studied in a manner similar to other natural sciences such as chemistry and biology...we have made and

> continue to make the wrong assumptions about the nature of the phenomena we study and hence we ask the wrong questions.

A more general criticism of research methods that use nonequivalent groups for comparison comes from Campbell who coined the term *quasi-experiment* in the early 1970's. In an interview in 1973 he was asked what was sacrificed when quasi-experimental designs are used instead of experimental (randomized) designs. He responded that *clarity of inference* is lost while *generalizability* may be improved (Salasin, 1973). The danger, of course, is that what is generalized (through repeated trials) may not be a valid interpretation of causality. Campbell argued that strong quasi-experiments will enhance both validity and reliability, and that causal inference can be improved by using maximally similar comparison groups.

In recent studies of online courses the *quality of the course* is ostensibly established by comparing the achievement of online students with that of traditional students. The "treatment," online instruction, is deemed effective if the outcome for online students is no worse than the outcome for the comparison group, traditional classroom students. A common interpretation of such a finding is that using online technologies *causes* the learning outcomes. Unfortunately, this type of research does not rule out the possibility that the ability and motivation (or other initial differences) of online students causes the learning outcomes. We might ask if these students would do just as well with a good textbook, a correspondence course, or a telecourse.

These simplified approaches to evaluating online course quality may prove to be misleading for a number of reasons stemming from the confounding problems of initial differences and causal attribution. First, they rely on an underlying assumption that online and classroom students are similar populations for statistical comparisons. Second, they infer that assessment of student achievement, usually measured by test performance, yields findings about

course effectiveness or quality and not something else, like student differences (and this is related to the first issue, also). Third, they infer that the introduction of online technologies causes differences in student achievement. Fourth, these approaches do not necessarily control for reactive effects such as the Novelty Effect[3], the John Henry Effect[4], and the Hawthorne Effect[5]. And finally, these approaches may camouflage important omissions in online course content by assuming that common classroom pedagogies are effective for all students (so, we should look beyond group means), or that online students need and benefit from the same pedagogical practices that have proven effective for traditional students in college classrooms and lecture halls.

One of the biggest problems with the research conducted to date has involved confusion about causation and experimentation. On the one hand, the difficulties of generating randomized experimental settings in the academic environment are fairly obvious; on the other hand, we see trivialization of the differences between online and classroom students to simple demographic differences. The difficulty seems to be in understanding the sorts of things that can actually be termed *causes*. Holland discusses this in great specificity in his paper, Statistics and Causal Inference (1986). In drawing associative inferences, researchers are simply exploring how student performance, such as a course grade, is associated with other variables of interest, such as student age or course delivery mode. In drawing causal inferences, however, researchers are

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[3] The Novelty effect refers to increased interest, motivation, or participation on the part of students simply because they are doing something different.

[4] The John Henry effect refers to control groups feeling threatened or challenged by being in competition with a new program or approach, and as a result, outdoing themselves and performing well beyond what would normally be expected.

[5] The Hawthorne effect refers to the effect upon behavior of the subject's knowing he or she is in an experiment. The Hawthorne effect is named after a Western Electric manufacturing section, in which output increased after experimental changes were made in the working conditions, but apparently as a result of attention rather than due to the specific changes.

exploring how some exposure to a particular course mode, or cause, resulted in some effect on the variable of interest, such as student performance. The underlying assumption is that student performance could have been different. A student's age, for example, could not have been a cause of his or her performance because the student could be no other age at that time. Age can only be *associated* with performance.

In studies that cite "no significant difference" between the performance of online and classroom students, the investigators are validating the null hypothesis, essentially asserting that *If online students had taken the classroom version of the course they would have achieved at the same level as they did in the online course.* One can't help but wonder what this statement actually means. The statement implies that only the mode of delivery is different. How is that accomplished in the real world of students and professors? Shavelson et al (1987) describe some of the researcher's challenges in trying to use an experimental design in a real-world distance learning environment: the student populations are heterogeneous not homogeneous; the implementation of a course is different on several dimensions from one site to another, from one semester to another, from one teacher to another; and the random selection process itself is likely to create distortions (i.e. self-selection is a characteristic of interest).

By building on what we have learned thus far about studying the effects of online education on student learning and performance, we can now begin to design research studies that will answer questions teachers have about designing online courses.

Future Directions for Research

The theory developed in this paper is that online courses, like all courses, should be designed for *students* and not designed for *the delivery mode*. That is, online courses should not be simple transformations of classroom strategies into online techniques. Instead, in designing an online course, teachers should start at the beginning by considering what students need from the course, and then think about appropriate strategies to address those needs.

Teachers will have to make a number of tradeoffs between quality and workload in this process, and new research into the effects of specific strategies will help teachers make those tradeoffs. This paper identifies three main points that can inform future research:

1. In evaluating the effectiveness of various online course strategies, one must first determine what defines success for the audience of interest.
2. Student learning and performance are influenced by a number of factors, including factors relating to student goals, student academic practices, and the mode of course delivery.
3. Previous research into the effects of online courses has not addressed causality sufficiently.

In a report published by the American Association for Higher Education, Lawrence and Green explore the ways educational quality has been measured (1980). Of particular interest are the ways institutions were measured for their ability to bring about or facilitate positive growth in students via an input-environment-output model. The input variables represented what students brought with them, the environment represented educational programs and other institutional characteristics to which students were exposed, and the output component was the desired goals and objectives of the academic experience, i.e. cognitive and affective changes. By

controlling for student input variables, the model assesses the contribution of the environmental variables to the outcomes; thus, isolating the impact of the institution. Using this model, future research into the contribution of online education to student learning should: (1) focus on defining appropriate student input variables that reflect the complex nature of students and learning; (2) be more explicit in defining the outcome variables and their appropriateness to the questions under study; and (3) provide information teachers can use to design online courses that meet the needs of all students, not only the "average" students or just the mature, capable learners.

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